

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE****NUMBER: 03-1-0210 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 2 11/08/00**PART DATA**

<b>PART NAME</b>	<b>PART NUMBER</b>
<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU : SURGE CHAMBER	MC282-0070-0001
SARGENT	9257-1

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

ACCUMULATOR, 750 PSIG PNEUMATIC, PREVALVE, 500 CU. INCHES.

**REFERENCE DESIGNATORS:** AU5  
AU6

**QUANTITY OF LIKE ITEMS:** 2**FUNCTION:**

THE ACCUMULATORS PROVIDE SUFFICIENT VOLUME OF HELIUM DOWNSTREAM OF CV9 FOR OPERATION OF THE FOLLOWING MPS VALVES:

LO2 PREVALVES (PV1,2,3)  
 LH2 PREVALVES (PV4,5,6)  
 LO2/LH2 17 INCH ET/ORBITER DISCONNECT VALVES AND LATCH ASSY (PD1,2)  
 LH2 4 INCH RECIRCULATION DISCONNECT VALVE (PD3)  
 LH2 RTLS DUMP VALVES (PV17,18)  
 LH2 HIGH POINT BLEED VALVE (PV22)  
 LO2 BLEED SHUTOFF VALVE (PV19)  
 LO2/LH2 RELIEF ISOLATION VALVES (PV7,8)

THEY PROVIDE FOR DAMPING OF PRESSURE FLUCTUATIONS DURING MULTIPLE VALVE OPERATION. THEY ALSO PROVIDE VALVE ACTUATION CAPABILITY SHOULD THE PNEUMATIC HELIUM SUPPLY BE LOST.

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**SUBSYSTEM NAME: MAIN PROPULSION**

**LRU: MPS PNEUMATIC SURGE CHAMBER**

**ITEM NAME: MPS PNEUMATIC SURGE CHAMBER**

**CRITICALITY OF THIS**

**FAILURE MODE: 1/1**

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**FAILURE MODE:**

RUPTURE/LEAKAGE

**MISSION PHASE:**

- PL PRE-LAUNCH
- LO LIFT-OFF
- OO ON-ORBIT
- DO DE-ORBIT
- LS LANDING/SAFING

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**

- 102 COLUMBIA
- 103 DISCOVERY
- 104 ATLANTIS
- 105 ENDEAVOUR

**CAUSE:**

METAL FATIGUE, FITTING LEAKAGE, MATERIAL DEFECT

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

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**REDUNDANCY SCREEN**

- A) N/A
- B) N/A
- C) N/A

**PASS/FAIL RATIONALE:**

A)

B)

C)

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

RESULTS IN LOSS OF PNEUMATIC HELIUM SUPPLY. HELIUM PRESSURE WILL NOT BE AVAILABLE TO CLOSE THE PREVALVES AT MECO OR THE ET/ORBITER UMBILICAL DISCONNECTS PRIOR TO ET SEPARATION. DISCONNECTS WILL CLOSE IN MECHANICAL

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BACKUP MODE DURING UMBILICAL RETRACT. FAILURE TO CLOSE THE LO2 PREVALVES AT MECO WILL RESULT IN UNCONTAINED ENGINE DAMAGE. RESULTS IN THE INABILITY TO MAINTAIN INJECTED HELIUM AND LO2 PRESSURE AT THE SSME PUMP, RESULTING IN POSSIBLE PUMP OVERSPEED AND EXPLOSION. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSIVE HAZARD.

ENGINE HELIUM SUPPLY SYSTEM IS CONNECTED TO VALVE ACTUATION SUPPLY BY THE CROSSOVER VALVE (LV10) AT MECO BY SOFTWARE COMMAND. THE ADDITIONAL HELIUM SUPPLY MAY NOT ACTUATE LO2 PREVALVES CLOSED.

RESULTS IN LOSS OF PNEUMATIC AND LEFT ENGINE HELIUM SUPPLY IF THE FAILURE OCCURS AFTER THE LEFT ENGINE HELIUM CROSSOVER VALVE (LV10) OPENS AT MECO. LOSS OF PNEUMATIC AND ALL ENGINE HELIUM SUPPLIES IF FAILURE OCCURS WHILE THE ENGINE 1 & 3 INTERCONNECT "OUT" VALVES (LV60, 64), ENGINE 2 INTERCONNECT "IN" VALVE (LV61) AND LV10 ARE OPEN, BEGINNING AT 20 SECONDS AFTER MECO.

EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. RUPTURE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF THE AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

RUPTURE AT ANY TIME MAY CAUSE SHRAPNEL DAMAGE TO CRITICAL ADJACENT HARDWARE/PERSONNEL.

**(B) INTERFACING SUBSYSTEM(S):**

SAME AS A.

**(C) MISSION:**

POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

**(D) CREW, VEHICLE, AND ELEMENT(S):**

POSSIBLE LOSS OF CREW/VEHICLE.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

NONE.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

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THE SURGE CHAMBERS ARE SPHERICAL IN SHAPE AND ARE FABRICATED FROM TWO TITANIUM 6AL-4V ALLOY FORGINGS WHICH ARE WELDED TOGETHER. THE DESIGN MEETS FRACTURE ANALYSIS REQUIREMENTS FOR 400 MISSIONS. FACTORS OF SAFETY ARE 2.0 PROOF AND 4.0 BURST.

**(B) TEST:**

ATP

EXAMINATION OF PRODUCT

HEAT TREAT VERIFICATION  
COUPON TENSILE TEST

WELD EVALUATION  
DIMENSIONALLY AND RADIOGRAPHICALLY INSPECTED

PROOF PRESSURE  
1700 PSIG

EXTERNAL LEAKAGE  
INTERNAL PRESSURE: 850 PSIG  
MAXIMUM LEAKAGE: 1X10-7 SCC/SECOND OF HELIUM

PENETRANT INSPECTION FOR SURFACE FLAWS

QUALIFICATION

CREEP TEST  
90 DAYS  
INLET PRESSURE: 850 PSIG  
TEMPERATURE: +130 DEG F

PRESSURE CYCLES  
20,000 CYCLES  
PRESSURE RANGE: 50 TO 800 PSIG  
PRESSURANT: WATER AT AMBIENT TEMPERATURE

VIBRATION

TRANSIENT  
1 OCTAVE/MINUTE

RANDOM VIBRATION  
13.3 HOURS IN EACH OF 2 AXES

BURST TEST  
3400 PSIG

RUPTURE TEST 4485 AND 4500 PSIG (TEST DATA)

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GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

RECEIVING INSPECTION

PARTS ARE VISUALLY INSPECTED FOR MATERIAL AND PROCESS CERTIFICATION. CERTIFIED DOCUMENTATION IS ON FILE FOR VERIFICATION AND TRACEABILITY.

CONTAMINATION CONTROL

PARTS ARE MAINTAINED TO CLEANLINESS LEVEL 100A. IN-PROCESS CLEANING IS PERFORMED PRIOR TO PENETRANT INSPECTION. THE ROUGH MACHINED HEMISPHERE IS SOLVENT CLEANED PRIOR TO SOLUTION TREATMENT AND AGE PROCESSES.

ASSEMBLY/INSTALLATION

ASSEMBLIES ARE VISUALLY INSPECTED FOR EVIDENCE OF RUPTURE DURING MANUFACTURING PROCESS INSPECTION. PROOF PRESSURE TEST IS CONDUCTED. BASE MATERIAL IS FREE OF DEFECTS AND CRACKS. INSPECTION FOR THE EXISTENCE OF ADHESIVE RESIDUE IS CONDUCTED WITH AN ULTRAVIOLET LIGHT FOR REMOVAL. MICRO-EXAMINATION OF GENERAL GRAIN STRUCTURE IS CONDUCTED AND VERIFIED BY INSPECTION. THE DIAMETERS OF FORGING ROLLED RING ARE CONCENTRIC WITHIN 0.030 TIR AND SURFACE ROUGHNESS IS FINISHED TO 250 RMS.

CRITICAL PROCESSES

PARTS ARE HEAT TREATED AND VERIFIED BY INSPECTION. ETCHING AND ANODIZATION OF EXTERIOR SURFACES OF SPHERE ARE VERIFIED BY INSPECTION. TIG WELDS AND PROOF PRESSURE ARE VERIFIED. MARKINGS DONE BY ELECTRO CHEM-ETCH PROCESS ARE VERIFIED.

NONDESTRUCTIVE EVALUATION

FORGINGS ARE VERIFIED BY ULTRASONIC INSPECTION AND WELDS ARE EXAMINED BY RADIOGRAPHIC INSPECTION. DYE PENETRANT IS PERFORMED ON EXTERNAL SURFACE AFTER LEAK TEST. HELIUM LEAK DETECTION IS VERIFIED.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING AND SHIPMENT IS VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

**(E) OPERATIONAL USE:**

PNEUMATIC ACTUATION HELIUM BOTTLE PRESSURE IS ON A DISPLAY IN COCKPIT. CREW ACTION IS TO FOLLOW NORMAL LEAK ISOLATION PROCEDURE. PRIOR TO MECO, ISOLATION

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VALVES (LV7, LV8) WILL BE REOPENED AND THE LEFT ENGINE HELIUM CROSSOVER VALVE (LV10) WILL BE OPENED.

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**- APPROVALS -**

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S&R ENGINEERING	: W.P. MUSTY	:/S/ W. P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: EARL HIRAKAWA	:/S/ EARL HIRAKAWA
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: BILL LANE	:/S/ BILL LANE
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS